STATE OF INDIANA

DEPARTMENT OF LOCAL GOVERNMENT FINANCE

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As part of the trending order for Calumet Township, the Department constructed an automated valuation model (AVM) to determine adjustment factors for residential improved property in Calumet Township. The purpose of this model was to adjust 2008 assessed values for this property class for the increase or decrease in value due to changing market conditions in the 2009 assessment year. This model was to have used 2008 sales data for residential improved property in Calumet Township. This data was provided to the Department by the Calumet Township Assessor.

Following the meeting at Calumet Township, the Department discovered that 2007 sales had also been used in determining the adjustment factor for residential improved property. Since market conditions have changed significantly from 2007 to 2008, and since enough 2008 sales were available, a different AVM was estimated using only 2008 sales data. The adjustment factor for this model remains .98, for a 2% decrease. However, the details of the model are different than that previously outlined. This document briefly explains the modeling process when only 2008 sales were used.

Data

The same dataset was used in constructing the new model, with the exception that only 2008 sales were used. All sales were marked valid for trending by the Calumet Township Assessor. This indicates that in his estimation, these sales are appropriate indicators of the market value-in-use of residential improved properties in Calumet Township.

In all, 362 sales were used. Summary statistics for these sales by tax district is displayed in the table below.

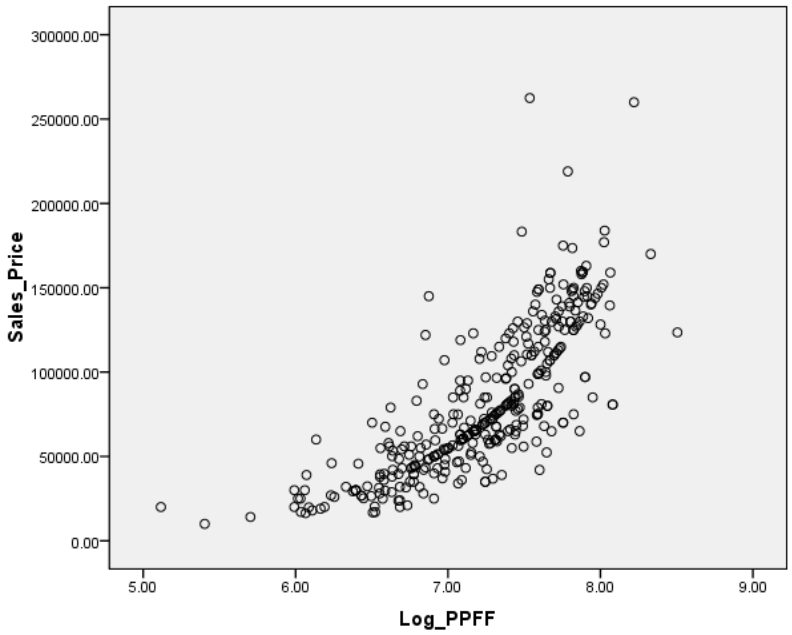
Tax District	Sales	Mean	Std. Dev	COV
1	29	79,375	32,460	41%
N. Gary	14	48,285	17,642	37%
Gary	213	62,249	31,352	50%
Griffith	106	127,451	33,771	26%
TOTAL	*362*	*82,173*	*43,396*	*53%*

Variable selection

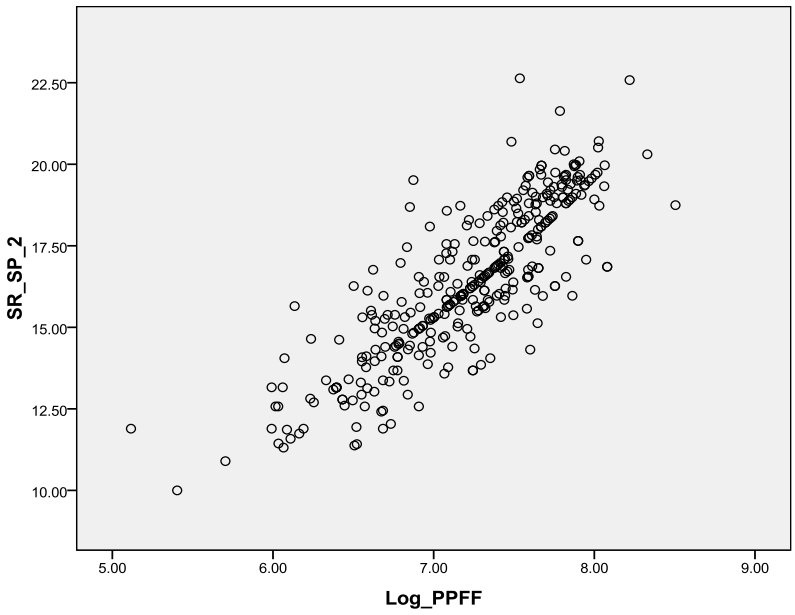
The main determinants of value were found to be parcel size, depreciation, and location. Of these, the relationship between sale price and parcel size is particularly important. The following table displays summary statistics for each measure considered:

Measure	Mean	Std. Dev	COV
Base Area	1,891	758	40%
Finished Area	1,268	548	43%
Square Feet	8,152	8,604	106%
Front Feet	52	19	37%

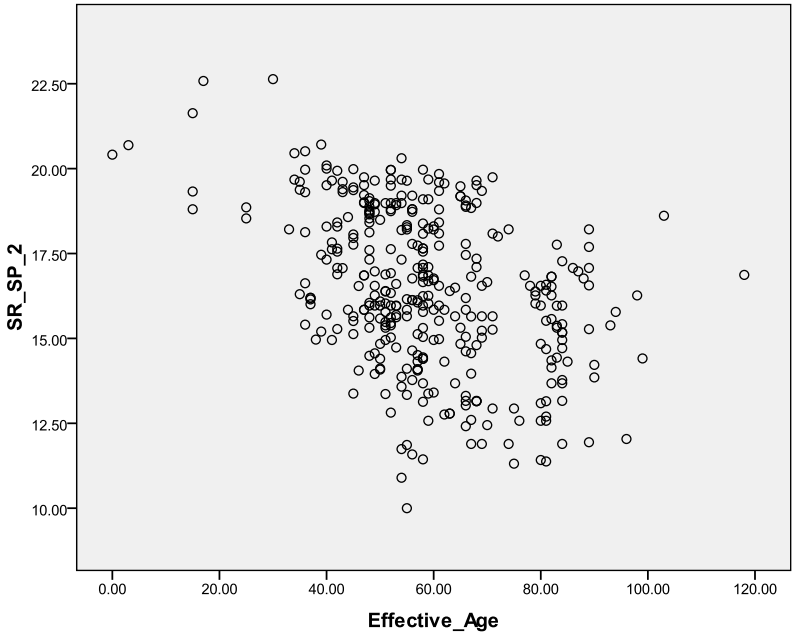
Of these measures, the front foot has the lowest coefficient of variation. For each property, this value was divided into the sales price to derive the price per front foot (PPFF). The natural log of this variable was then taken to correct for non-constant variance. A plot of the sales price against the PPFF is shown in graph 1:



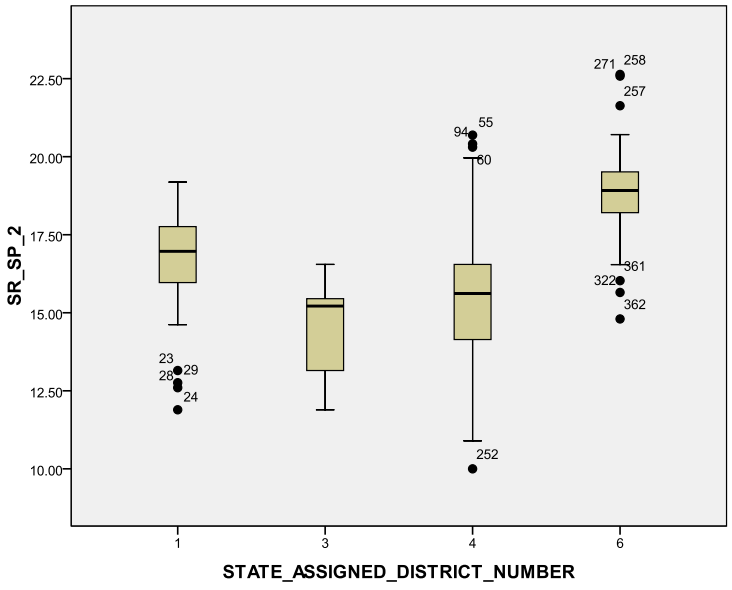
Since this relationship is not linear, the dependent variable (sales price) was transformed by taking its fourth root. The resulting relationship is plotted in the following graph:



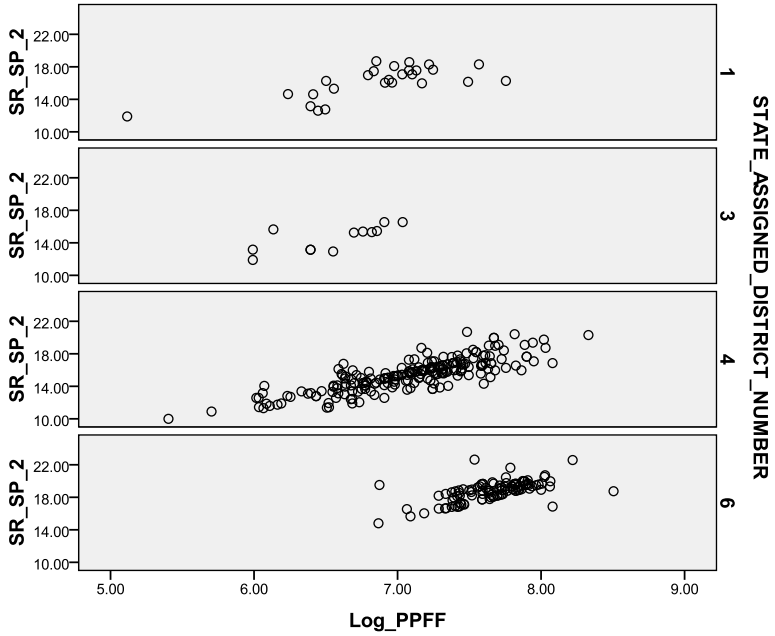
Deprecation is also an important determinant of value. This was determined by substracting the year the house was constructed from 2008. The resulting variable, called Effective Age, is plotted against the dependent variable in the following graph:



This relationship is broadly linear, although not very strong. Additional curve fitting models did not significantly improve the relationship between the dependent variable and effective age. Therefore, this variable was included without change. Location is the final determinant of value. The following graph shows the distributions of sales prices in the four tax districts that make up Calumet Township:



This graph shows that the median sales price is significantly different in each of the four tax districts. Examination of the dependent variable and PPFF by tax district shows an intercept shift but no significant difference in slope, as shown in the following graph.



Based on this analysis, one indicator variable was constructed for each of tax districts 1, 2, and 6. Tax district 4 was used as the baseline, as it had the most sales.

Model Specification

The general valuation equation used was:

$$\sqrt[4]{SALEPRICE} = \beta_0 + \beta_1 * \ln(PPFF) + \beta_2 * AGE + \sum_{i=3}^{5} \beta_i * DISTRICT_i + \varepsilon$$

The specific equations for each tax district were:

$Gary\ (004)$ $$\sqrt[4]{SALEPRICE} = \beta_0 + \beta_1 * \ln(PPFF) + \beta_2 * AGE + \varepsilon$$

$Calumet\ (001)$ $$\sqrt[4]{SALEPRICE} = (\beta_0 + \beta_{DISTRICT\_1}) + \beta_1 * \ln(PPFF) + \beta_2 * AGE + \varepsilon$$

$N.Gary\ (003)$ $$\sqrt[4]{SALEPRICE} = (\beta_0 + \beta_{DISTRICT\_3}) + \beta_1 * \ln(PPFF) + \beta_2 * AGE + \varepsilon$$

$Griffith\ (006)$ $$\sqrt[4]{SALEPRICE} = (\beta_0 + \beta_{DISTRICT\_6}) + \beta_1 * \ln(PPFF) + \beta_2 * AGE + \varepsilon$$

Results

The valuation model was calibrated using multiple regression. All calculations were performed in SPSS, version 17.0. Output from the model is displayed in the following tables:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.907	.822	.820	.98619

ANOVA

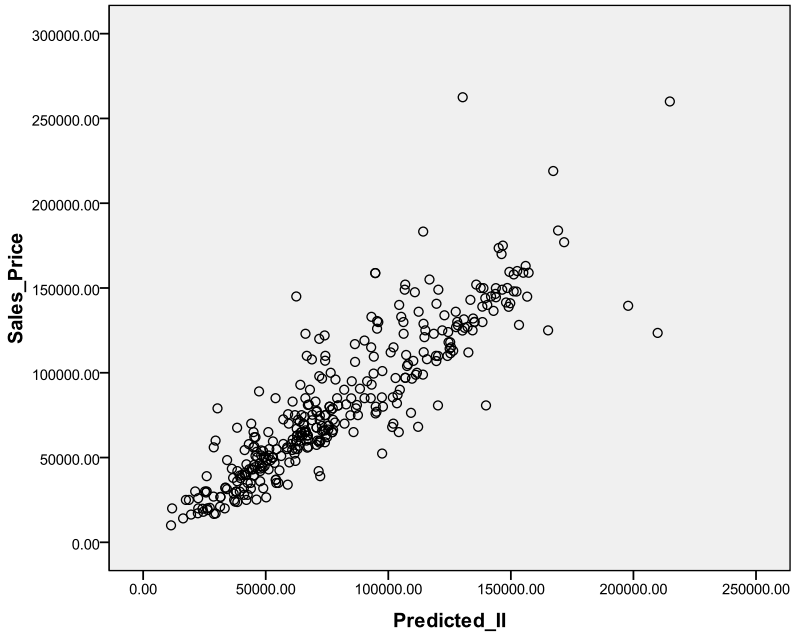
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1571.594	5	314.319	323.185	.000[a]
	Residual	339.425	349	.973		
	Total	1911.019	354			

Coefficients

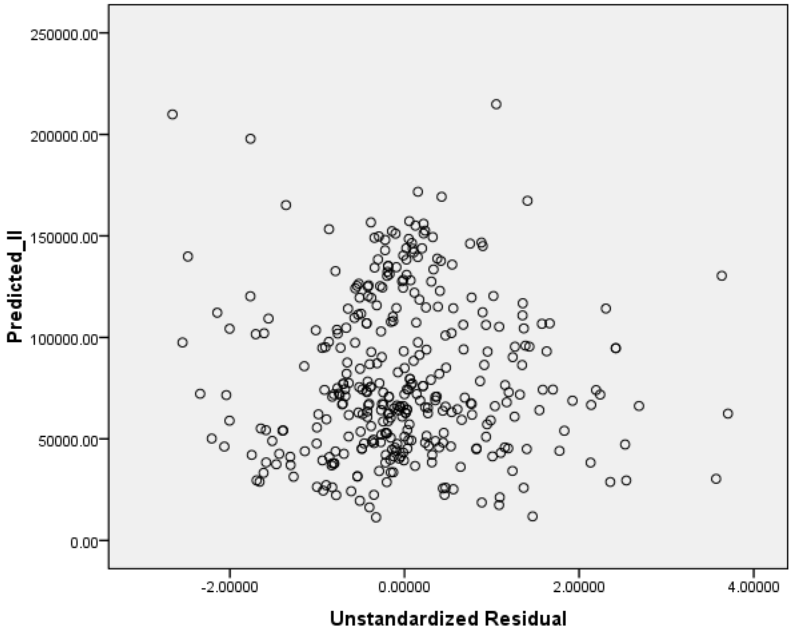
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-5.055	.922		-5.482	.000
	Log_PPFF	3.144	.124	.710	25.438	.000
	Effective_Age	-.029	.003	-.203	-8.649	.000
	DistrictOne	1.412	.207	.159	6.814	.000
	Griffith	1.241	.140	.243	8.876	.000
	Gary_North	.896	.300	.070	2.984	.003

Overall, the model explains 82% of the variance in the dependent variable. The variables are statistically significant at $\alpha = 0.05$ when considered as a whole and individually. The signs of the two continuous variables (PPFF and Effective Age) are also consistent with appraisal theory.

Predicted values are plotted against sales price below:



A plot of predicted values versus unstandardized residuals does not reveal violations of the assumptions of multiple regression:



Development of Adjustment Factor

A ratio study was conducted on the predicted values. The results are displayed in the following chart:

Ratio Statistics for Predicted_Values / Sales_Price

Median	1.021
Price Related Differential	1.057
Coefficient of Dispersion	.176

The median ratio for all residential improved properties is 1.02, indicating that these properties are over-assessed by 2%. The adjustment factor was calculated by dividing the median ratio (1.02) into 1 (the level of assessment in Indiana is 100%). The resulting factor was 0.98.